Presentation Title: Arc Fault Circuit Breaker Development and Implementation

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Abstract Summary: About one and a half years ago, the Federal Aviation Administration (FAA), the Naval Air Systems Command (NAVAIRSYSCOM), and the Office of Naval Research (ONR) began a joint program to develop Arc Fault Circuit Breakers. Since that time, there has been an unprecedented level of interest in the technology from all corners of the military and commercial aviation communities within the United States and internationally. This paper will provide an overview of the progress of AFCB development to date, and address newly emerging issues concerning the deployment, operation, and support, of AFCB's aboard operational aircraft.

Although difficult to quantify precisely, a review of military and commercial aviation incident reports reveals many instances of arcing. Some of these have resulted in the loss of the aircraft. Arcing can wreak havoc on an aircraft by destroying large portions of wire bundles, igniting flammable materials in and around the wire bundle, or by transferring dangerous levels of energy into other systems due to the collocation of systems wiring within the same bundle (likely cause in the TWA-800 accident). Development of a form, fit, and function replacement of thermal breakers with an arc fault circuit breaker will mitigate the effects of arcing by detecting the arc and removing power from the affected circuit, greatly improving the safety of electrical systems.

This paper will describe development efforts to date, including ground and flight tests. Tests were performed to characterize arc fault signatures, normal load signatures, and signatures produced during bus transfers and other transient conditions. Prototype breakers were tested by producing arcs with various methods. The paper will also describe early results of flight-testing and the occurrence of nuisance

tripping. In parallel with these test efforts, the SAE AE-8B1 committee is developing an AFCB specification. The progress of the AE-8B1 committee will be described.

There are many practical considerations that have to be considered when considering replacing thermal breakers with AFCB devices. This paper will describe the benefits of the technology as well as the potential operational difficulties that must be considered when implementing arc fault protection. With consideration of the pro's and con's, the paper will present a number of potential approaches to retrofitting AFCB's onto aircraft.

Because thermal circuit breakers do not trip circuits that are experiencing intermittent arcing, it is presumed that some quantity of arcing is presently occurring, undetected. Therefore it is further presumed that, as the use of AFCB's increases, so to shall the number of tripping incidences. This will require troubleshooting and maintenance to identify the location of the fault and completing its repair. And in the case of a potential nuisance trip, troubleshooting efforts could be problematic. This paper will describe potential tools to assist with the troubleshooting of arc trips.

Lastly, the paper will describe the possible of additional arc fault protection technology and enhancements. These may include incorporation of arc fault protection into solid-state circuit breakers, contactors, and generator control units. DC AFCB's are required to protect the large numbers of 28V circuits. Other improvements, such as the incorporation of BIT to monitor AFCB functions, or development of AFCB's with self contained troubleshooting.